No. 0092-00-04

putting research to work

BRIEF

RESEARCH DEVELOPMENT & TECHNOLOGY TRANSFER

The Wisconsin Department of Transportation

Are SuperPave Lifts Harder to Compact?

What's the Problem?

In 2000, WisDOT began its adoption of Superpave design criteria. Two notable facets of Superpave are that the mixtures it calls for are a different aggregate blend than traditional Wisconsin hot-mix asphalts, and the suggested Superpave lift thickness ranges from 2.3 to 3.5 times the nominal maximum aggregate size used in the mix.

Traditional practice in Wisconsin, however, calls for lifts of only about twice the maximum aggregate size, resulting in overlays of 1.5 to 2 inches. In Superpave terms, these would be considered "thin lift." Because Superpave would require thicker overlays than traditional Wisconsin practice, it would also require a reshaping of contractor expertise in compressing the hot-mix asphalt, because that expertise has been founded on decades of thin-lift practice.

Hence, a modified version of Superpave standards should be explored to discover how effective Superpave mixes could be at thinner lifts than Superpave guidelines direct, in order to better suit the HMA experience of Wisconsin contractors.

Research Objectives

Researchers attempted to meet the following objectives:

1. Quantify effects of varied lift thickness on compaction and performance of selected asphalt pavement mixtures used commonly in Wisconsin.
2. Explore the role of aggregate size and lift thickness on compaction and air void in the laboratory with the Superpave Gyratory Compactor, and compare results to field compactions.
3. Develop revised guidelines for minimum lift thickness for Superpave mixtures in Wisconsin.

Research Methodology

Researchers pursued the above objectives through four tasks.

1. Review of Superpave literature and Superpave Gyratory Compactor Studies, and research of WisDOT construction databases.
2. Survey of contractors and state highway agency officials throughout the Midwest on lift thicknesses employed with Superpave.
3. Laboratory analysis of mix design applications, entailing use of the Superpave Gyratory Compactor, evaluating thickness and compaction energy, volumetric analysis, and aggregate degradation during compaction.
4. Field study of related mix design applications at four construction sites, entailing compaction of various lift thicknesses, and evaluation of materials, bases and gradations on density.

Investigators
Barry Paye and Hussain Bahia, University of Wisconsin-Madison, Department of Civil and Environmental Engineering

Current WisDOT specifications for lift thickness adopted in 2000 will remain in place.

Table 2.1. WisDOT Lift Thickness Specifications

Nominal Size (in Inches (mm))	Minimum Layer Thickness (in Inches (mm))	Ratio (Thickness/Nominal Size)
1.5 (37.5)	3.5 (89)	2.33
1.0 (25.0)	3.25 (83)	3.25
0.75 (19.0)	2.25 (57)	3
0.5 (12.5)	1.75 (44)	3.5
0.375 (9.5)	1.5 (38)	4

"This research shows that thinner, coarser lifts don't seem to be any more difficult to compact than thick ones – in the field. We still have more to learn about why lab mixes didn't show the same results."

- Len Makowski, WisDOT District 2, Waukesha

Research Results

Results of surveys, laboratory and field research were not able to produce definitive recommendations for revising lift thickness guidelines for Superpave mixtures in Wisconsin. Results did not suggest a need to change Superpave lift thickness recommendations to match traditional Wisconsin practices.

1. Literature and surveys indicate coarse Superpave mixtures have been more difficult to compact than traditional mixes, but in Wisconsin no direct correlation between lift thickness and density emerged.
2. While contractors differ widely in lift thickness recommendations from 1.75 to 4 times nominal maximum aggregate size, most Midwestern states recommend lifts of 3 to 4 times nominal maximum aggregate size.
3. In the laboratory, sample thickness significantly impacted the compaction necessary to achieve density, eclipsing other factors such as aggregate source and gradation; achieving desired density required lifts of 4 to 6 times aggregate size. Thinner lifts required more compaction to achieve desired density.
4. Field results differed significantly from the Superpave Gyratory Compactor lab findings, indicating that in a given number of roller passes, changes in lift thickness had little impact on final density ratios; lifts at 3.0 ratios to aggregate or less required no more compaction energy than thick lifts.

Future Research Direction

This study was not unable to produce revised lift thickness recommendations for Superpave mixtures in Wisconsin, nor was it able to suggest a need for lift thicknesses of less than those recommended by Superpave or other Midwest state transportation agencies. Researchers speculated that the reasons for discrepancies between this study's lab and field results included the impact of soft field bases, climactic conditions and irregularity in aggregates.

Investigators recommend testing these field-lab discrepancies by conducting further field-lab comparisons of mixes not examined in this study. Researches also recommend further analysis of Superpave Gyratory Compactor performance to learn how to refine its use to better duplicate field conditions and variables.

Wisconsin Department of Transportation
RD&T Program
4802 Sheboygan Ave.
Madison, WI 53707
Nina McLawhorn
Research Administrator
608-266-3199

Minimum Pavement Lift Thickness for Superpave Mixtures

0092-00-04

December 2001

For more information, contact:

Leonard Makowski: leonard.makowski@dot.state.wi.us